

# Hexamethylene Diisocyanate

822-06-0

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## Hazard Summary

Hexamethylene diisocyanate is used as a polymerizing agent in polyurethane paints and coatings. Acute (short-term) exposure to high concentrations of hexamethylene diisocyanate in humans can cause pulmonary edema, coughing, and shortness of breath. Hexamethylene diisocyanate is also extremely irritating to the eyes, nose, and throat. Human studies have suggested that chronic (long-term) exposure to hexamethylene diisocyanate may cause chronic lung problems. Animal studies have reported respiratory effects from chronic inhalation exposure and skin irritation and sensitization from dermal exposure to hexamethylene diisocyanate. No information is available on the reproductive, developmental, or carcinogenic effects of hexamethylene diisocyanate in humans. EPA has not classified hexamethylene diisocyanate for carcinogenicity.

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Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (4) and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Hexamethylene Diisocyanate. (2)

## Uses

- One of the main uses of hexamethylene diisocyanate is as a polymerizing agent in polyurethane spray paint formulations and coatings (e.g., automobile paint). (5)
- Hexamethylene diisocyanate is used in the preparation of dental materials, contact lenses, and medical adsorbents. (1)

## Sources and Potential Exposure

- The general public may be exposed to hexamethylene diisocyanate through inhalation of air containing the chemical after it is released during spray applications of polyurethane paints. (1)
- Occupational exposure to hexamethylene diisocyanate may occur through inhalation of vapors or through dermal contact. (1)

## Assessing Personal Exposure

- No information is available on the assessment of personal exposure to hexamethylene diisocyanate.

## Health Hazard Information

### Acute Effects:

- Acute exposure to high concentrations of hexamethylene diisocyanate can cause pulmonary edema, coughing, shortness of breath, and labored breathing in humans. (1,2)
- Hexamethylene diisocyanate is extremely irritating to the eyes, nose, and throat in humans. (1) Acute
- animal tests in rats have shown hexamethylene diisocyanate to have **extreme** acute toxicity from inhalation exposure and **moderate** to **high** acute toxicity from oral exposure. (3)

### Chronic Effects (Noncancer):

- Epidemiologic studies have suggested that chronic exposure to hexamethylene diisocyanate may cause chronic lung problems. (1,2,5)
- Animal studies have reported effects on nasal tissue, the respiratory tract, and the lungs from chronic inhalation exposure to hexamethylene diisocyanate. (5)
- Dermal exposure resulted in skin irritation and sensitization in guinea pigs, rabbits, and mice. (5)
- The Reference Concentration (RfC) for hexamethylene diisocyanate is 0.00001 milligrams per cubic meter (mg/m<sup>3</sup>) based on the degeneration of olfactory epithelium in rats. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (4)
- EPA has high confidence in the study on which the RfC was based because it was well conducted in an adequate number of animals and placed particular emphasis on possible effects on the upper, as well as the lower, respiratory tract, and both a no observed adverse effect level (NOAEL) and a lowest observed adverse effect level (LOAEL) were identified. Confidence in the data base is medium because of the absence of reproductive/developmental and metabolic studies. Consequently, confidence in the RfC is medium. (4) EPA
- has not established a Reference Dose (RfD) for hexamethylene diisocyanate. (4)

#### Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of hexamethylene diisocyanate in humans.
- There was no effect on male or female reproductive organs in one rat inhalation study. (5)

#### Cancer Risk:

- No information is available on the carcinogenic effects of hexamethylene diisocyanate in humans.
- No increase in cancer was reported in one study of rats exposed to hexamethylene diisocyanate via inhalation for two years. (5)
- EPA has not classified hexamethylene diisocyanate for carcinogenicity.

## Physical Properties

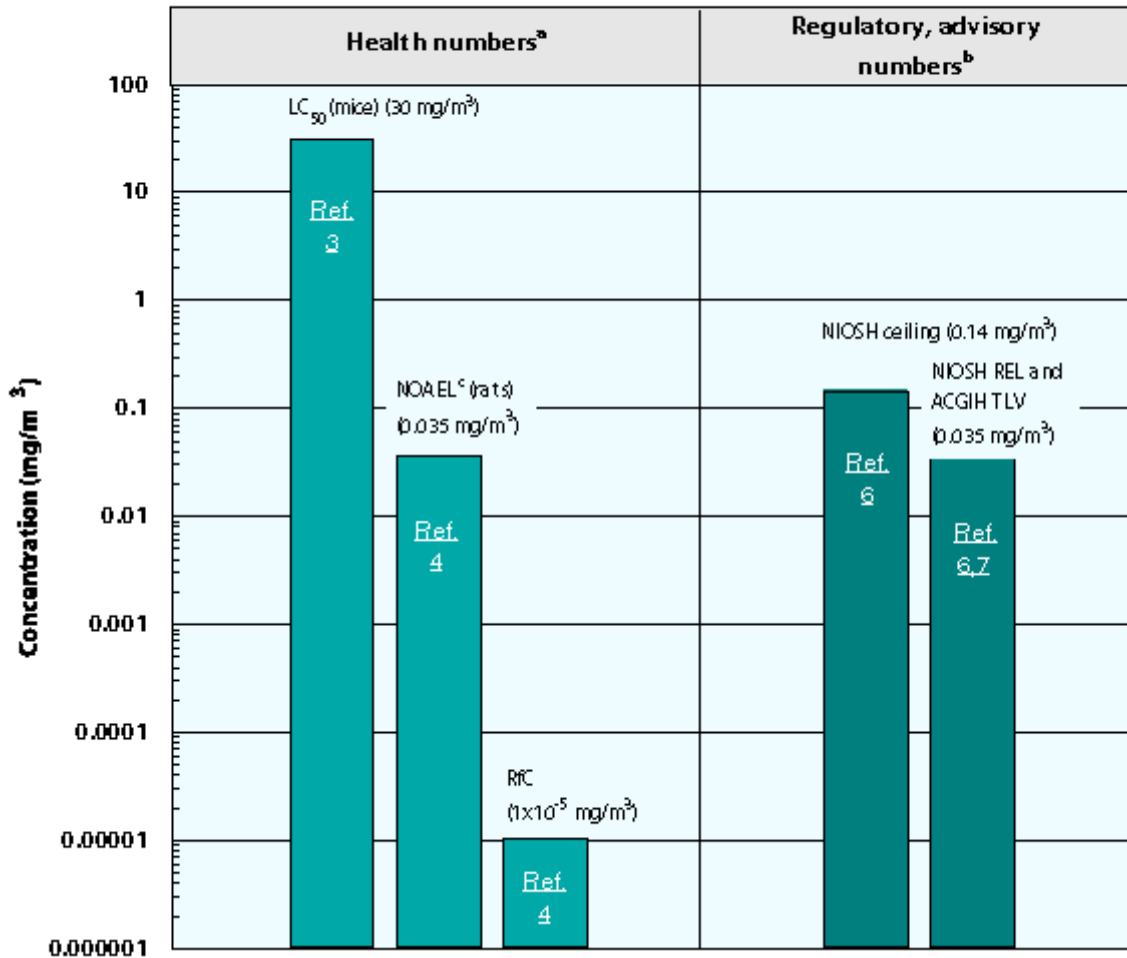
- Hexamethylene diisocyanate is a colorless liquid with an irritating odor. (2)
- The odor threshold for hexamethylene diisocyanate is 0.001 parts per million (ppm). (1)
- The chemical formula for hexamethylene diisocyanate is C<sub>8</sub>H<sub>12</sub>N<sub>2</sub>O<sub>2</sub>, and the molecular weight is 168.22 g/mol. (1)
- The vapor pressure for hexamethylene diisocyanate is 0.05 mm Hg at 25 °C. (1)

#### Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m<sup>3</sup>:  $\text{mg/m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound}) / (24.45)$ . For hexamethylene diisocyanate: 1 ppm = 6.9 mg/m<sup>3</sup>.

### Health Data from Inhalation Exposure

# Hexamethylene-1, 6-Diisocyanate



ACGIH TLV --American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

LC<sub>50</sub> (Lethal Concentration<sub>50</sub>)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

NIOSH REL --National Institute of Occupational Safety and Health's recommended exposure limit; NIOSH--recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

NIOSH REL ceiling --NIOSH's recommended exposure limit ceiling; the concentration that should not be exceeded at any time.

The health and regulatory values cited in this factsheet were obtained in December 1999.

<sup>a</sup> Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

<sup>b</sup> Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. NIOSH and ACGIH numbers are advisory.

<sup>c</sup> The NOAEL is from the critical study used as the basis for the EPA RfC.

Summary created in April 1992, updated January 2000

## References

1. U.S. Department of Health and Human Services. Hazardous Substances Data Bank (HSDB, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
2. New Jersey Department of Health. Hazardous Substance Fact Sheet on Hexamethylene Diisocyanate, New

Jersey Department of Health, Trenton, NJ. 1986.

3. U.S. Department of Health and Human Services. Registry of Toxic Effects of Chemical Substances (RTECS, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
4. U.S. Environmental Protection Agency. [Integrated Risk Information System \(IRIS\) on Hexamethylene-1,6-Diisocyanate](#). National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.
5. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Hexamethylene Diisocyanate. Public Health Service, U.S. Department of Health and Human Services. Atlanta, GA. 1998.
6. National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 1997.
7. American Conference of Governmental Industrial Hygienists (ACGIH). 1999 TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents. Biological Exposure Indices. Cincinnati, OH. 1999.